

Department of Industrial and Systems Engineering
IE3100R System Design Project AY2010/11
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1. BACKGROUND

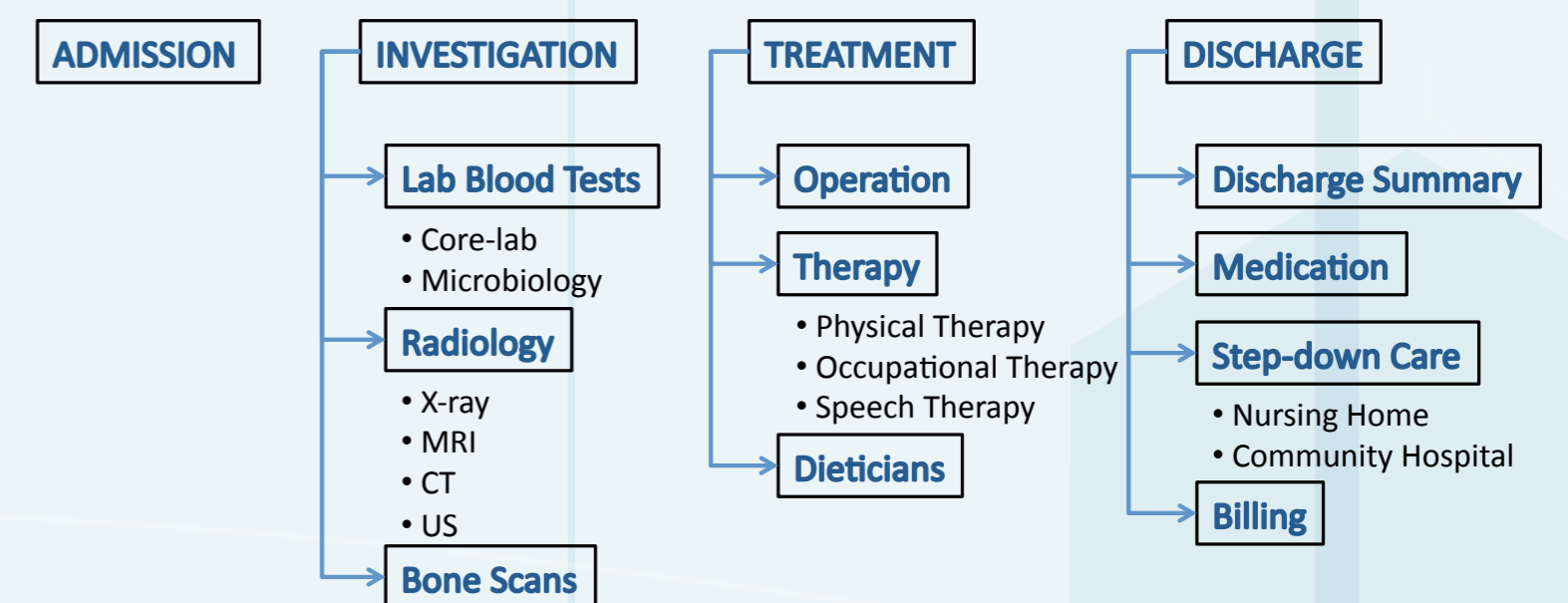
Khoo Teck Puat Hospital (KTPH), being the latest public hospital in Singapore, began its operations with the opening of Specialists and Outpatient Clinics on 28th March 2010. The A&E and inpatient wards opened progressively. KTPH began admitting patients since 28th July. KTPH aims to reduce its **Average Length of Stay (ALOS)** of patients. ALOS is calculated as: **Sum of Patient Days/Discharge or Death Patient Counts** in a given period.

2. OBJECTIVE

The current weekly ALOS of General Orthopedic patients varies from **4.4 to 5.6 days**.
The objective of this project is:
To reduce the ALOS of General Orthopedics group in KTPH by a reasonable extent.

3. PROCESS MAPPING

Different stages of treatment process and the roles&responsibilities of various parties involved have been studied through ward orientation and interviews with key staff. Generic treatment path for GO patient in KTPH:



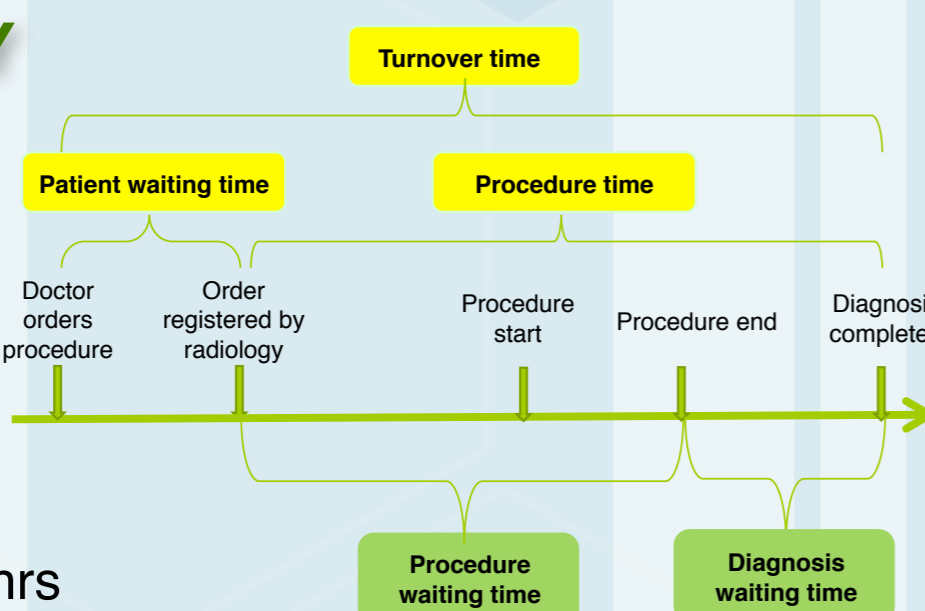
4. CURRENT SITUATION ANALYSIS

4.1 RADIOLOGY

System Tests Data

Procedure waiting time:

- ❖ MRI/US < 2 hrs
- ❖ CT < 3 hrs
- ❖ X-ray (98%) < 2 hrs

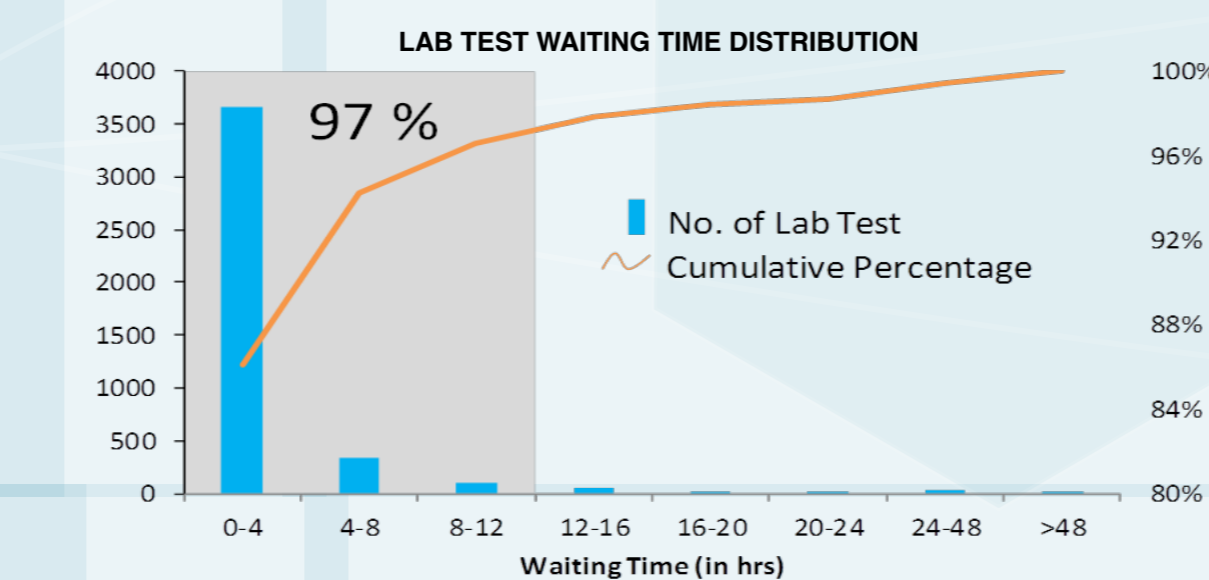
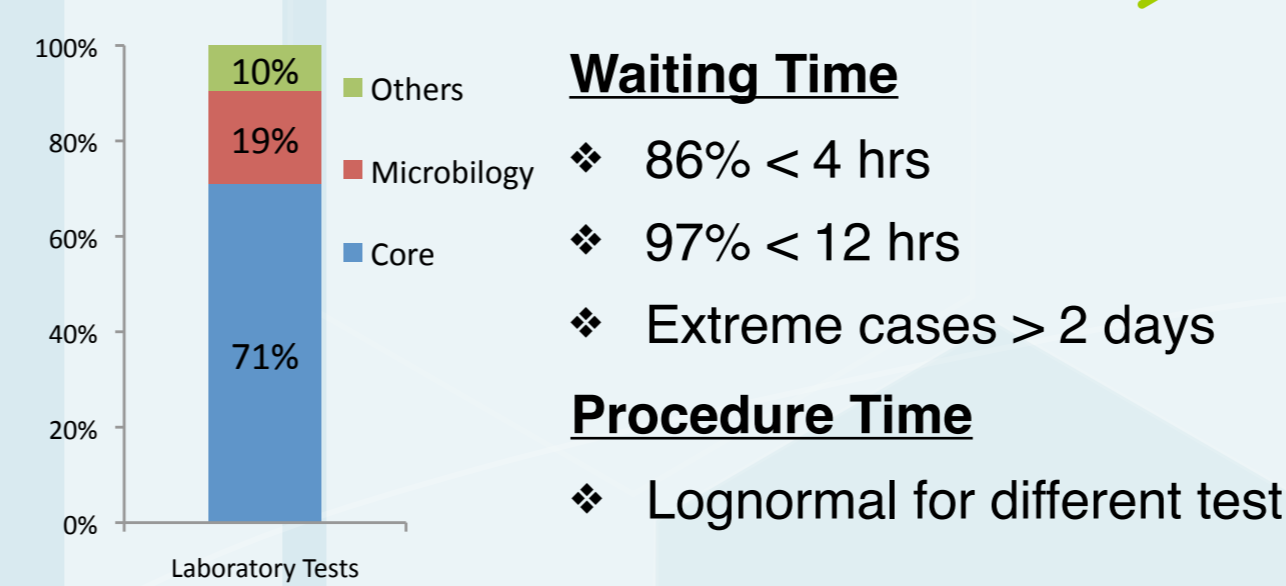
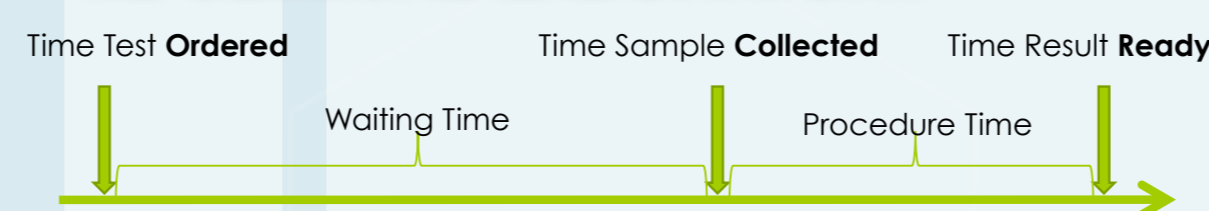


	Turn Over Time	Procedure Time	PL Waiting Time	Efficiency (Procedure / Turn Over Time)
MAX	4 days	3 days	2 days	93.86%
MIN	50 min	6 min	21 min	1.38%
AVERAGE	14 hrs	5 hrs	8 hrs	36.83%

Information Flow Data

- ❖ Turnover Time: 76.5% < 12 hrs
- ❖ Procedure Time: 86.1% < 5 hrs
- ❖ Patient Waiting Time: 44.1% < 4 hrs

4.2 CLINICAL LABORATORY



4.3 DISCHARGE

Delay Causes Breakdown

- ❖ Clinical
- ❖ Step-down Care (32%)
- ❖ Family/Personal
- ❖ Operational (6%)

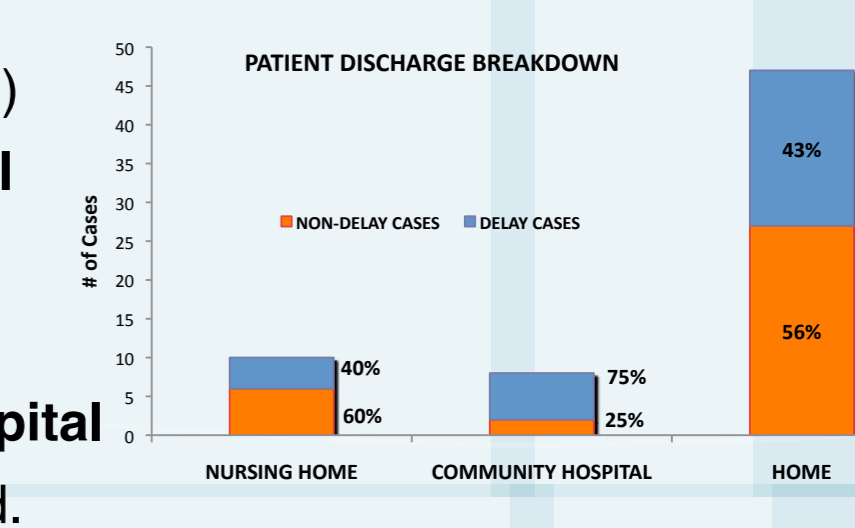
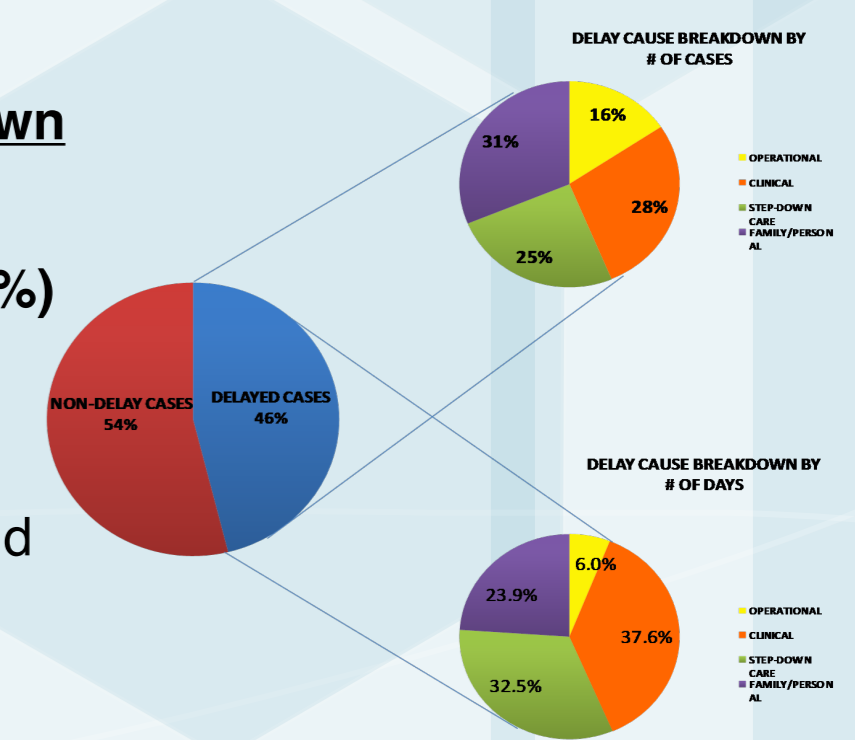
Main areas hospital could improve on.

D/C Disposition Breakdown

Delay/Non-Delay (%)

- ❖ Nursing Home (40/60)
- ❖ Community Hospital (75/25)
- ❖ Home (44/56)

D/C to Community Hospital more likely to be delayed.



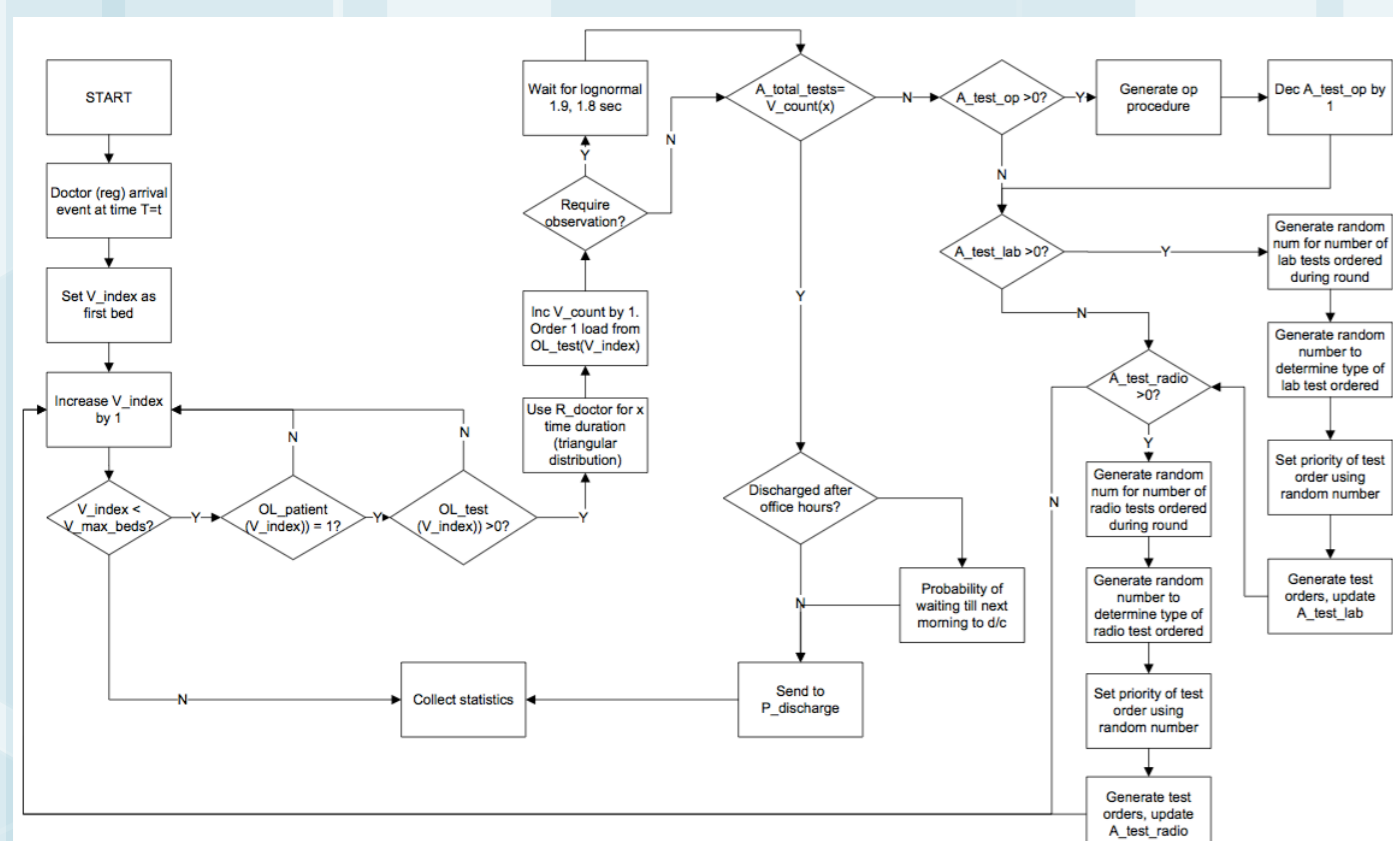
5. SIMULATION MODEL

5.1 DESIGN&FORMULATION

Key Features of Model

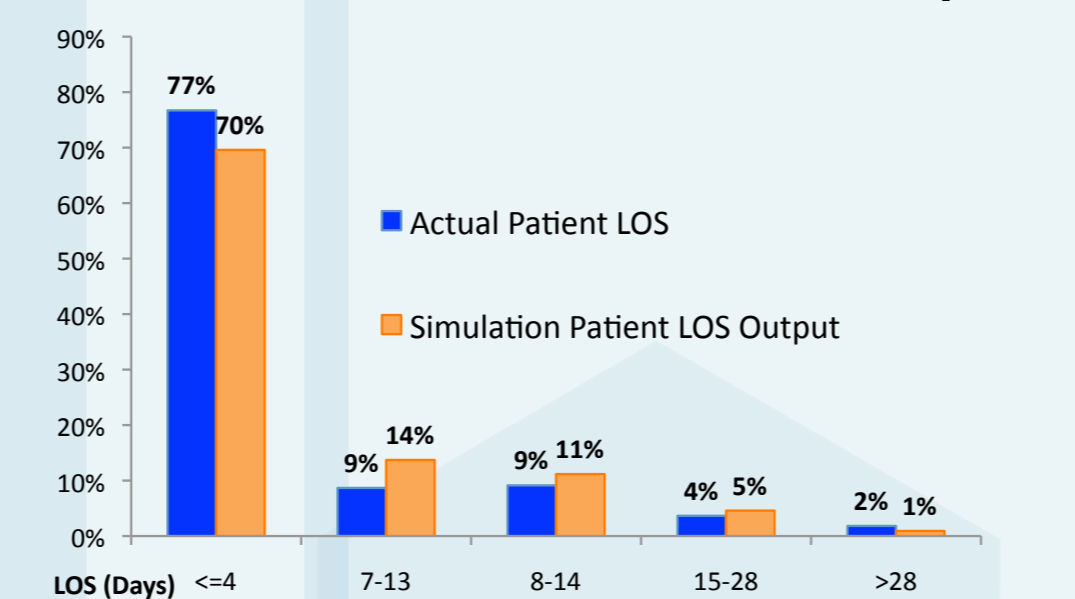
- ❖ 64 beds for General Orthopedics patients
- ❖ 3 departments: clinical laboratory, radiology & operating theater
- ❖ 4 teams of doctors on duty
- ❖ Simulation run-time of 3 years
- ❖ Warm-up period of 3 months

Doctor Arrival Simulation Flowchart



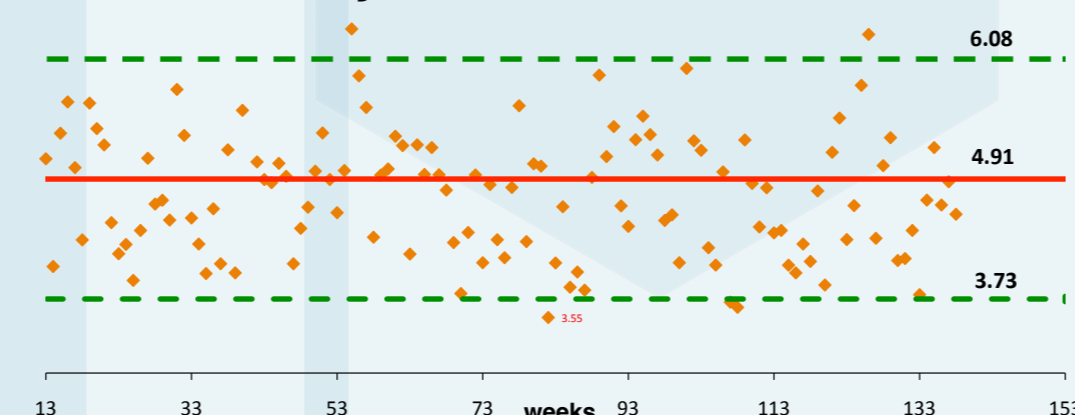
5.2 MODEL VALIDATION

Patient LOS Profiles Actual vs Output



Weekly ALOS Actual vs Output

Upper/lower limits are calculated based on actual weekly ALOS of KTPH



Model Validated

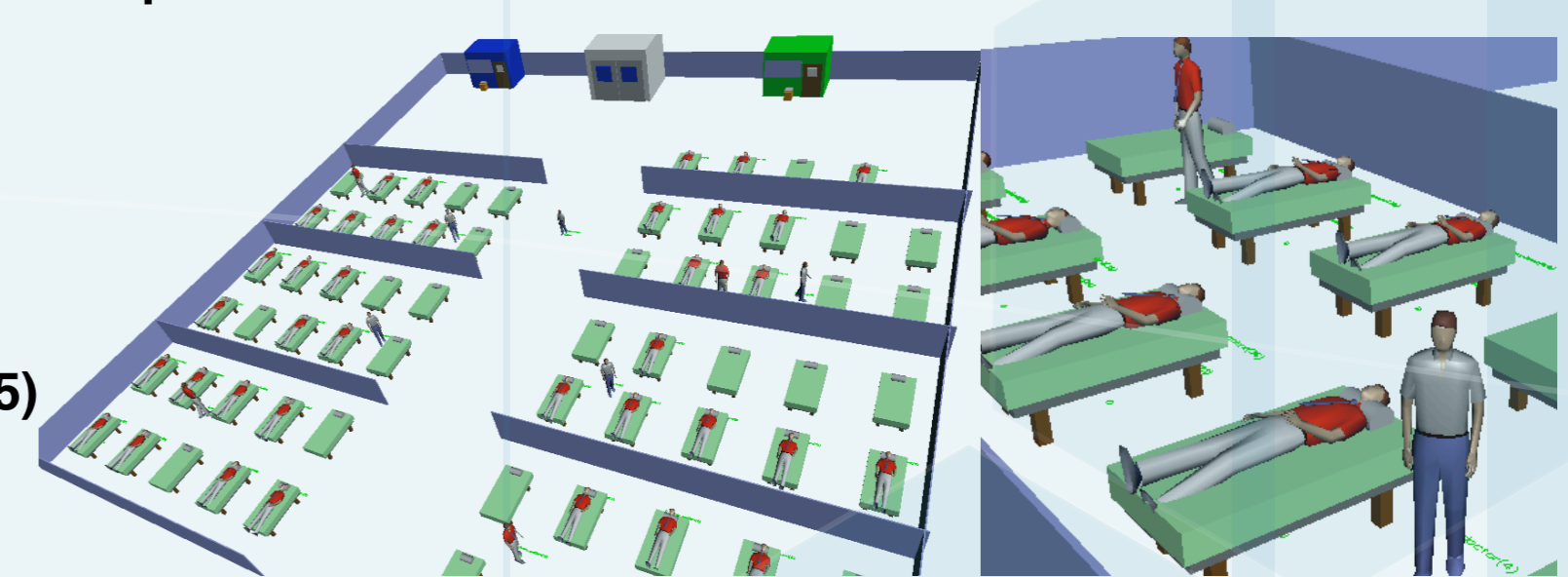
- ❖ Patient LOS profiles reasonably match for LOS subgroups (%)
- ❖ Weekly ALOS outputs: MAX(7.30)&MIN(3.55)
- ❖ Weekly ALOS outputs fluctuating within reasonable range defined

5.3 OUTPUT ANALYSIS

Sensitivity Analysis of Main Factors

Factor	Range of Effect on ALOS			
	LOW		HIGH	
Urgent Laboratory Ratio	-0.8%	1.3%	-0.4%	0.8%
Urgent Radiology Ratio	-2.9%	-0.4%	-0.8%	1.9%
Observation Delay (Contusion)	-10.4%	-4.9%	5.2%	6.6%
Observation Delay (Infection)	-4.4%	0.2%	-0.8%	2.1%
Observation Delay (Wound)	0.0%	0.0%	0.6%	1.0%
Observation Delay (Inflammation)	-2.3%	-0.6%	-6.2%	0.0%
Observation Delay (Others)	-4.4%	-2.3%	-2.3%	1.9%
Discharge Delay Probability	-9.1%	-4.0%	1.9%	3.8%
Set up a Community Hospital	-7.6%		-8.9%	
Extend MRI&CT to 24hrs Service	-1.5%		-3.6%	
Shift Evening Dr. Round 0.5h Early	1.3%		0.2%	
Shift Evening Dr. Round 1h Early	-0.6%		-5.4%	
Shift Evening Dr. Round 1.5h Early	-0.2%		-3.3%	
Hire More Phlebotomists	-2.5%		-6.2%	

Snapshot of Simulation Model



6. RECOMMENDATIONS

1. Setting up community hospital

for current situation, 30% of the delayed discharges are due to liaison with step-down care; the delays can be up to 10 days

2. Hire more phlebotomists

To reduce blood sample collection time for lab tests

3. Shift evening doctor's round time 1-1.5 hours earlier OR extend MRI & CT to 24 hours services.

To reduce the delay in diagnosis waiting time due to non-24 hour services.

4. Standardize procedures for making interdepartmental referrals

5. Implement common IT platform

6. Emphasize on tests preparation procedures

